HYDROMORPHOLOGICAL CHARACTERISTICS OF JALANGI RIVER IN MORIBUND DELTAIC PLAIN OF WEST BENGAL

Submitted by:

Dibyendu Mondal

Department of Geography,

Visva-Bharati, Santiniketan.

Supervisor:

Prof. SUTAPA MUKHOPADHYAY

Department of Geography,

Visva-Bharati, Santiniketan.

Mukhopadhyay 15/7/16

प्रोफेसर और विभागाध्यक्ष
Professor & Head
भूगोल विभाग
Department of Geography
विश्वभारती, शान्तिनिकेतन
Visva-Bharati, Santiniketan

CONCEPTUAL FRAMEWORK:

Hydromorphology is the study of structure and evolution of the Earth's water resources. It deals with the origins of the Earth's water resources and dynamic morphology of the Earth's water resources in spatio-temporal context. The word ***hydro*** defines water, word ***morpho*** comes from ***morfe*** which means form and shape and lastly ***logy*** driven from Latin word ***logos*** means to describe. So, Hydromorphology is the description or study of forms or structures developed under the influence of water resources in spatio-temporal context in the earth.

Analogous to geomorphology, which deals with the dynamic morphology of the earth system, Hydromorphology addresses the dynamic morphology of water resource systems caused by both natural and anthropogenic influences (R. M. Vogel, 2011). This new field (a subfield of hydrology), deals with the structure, evolution, and dynamic morphology of hydrologic systems over time (e.g., years, decades, and centuries) as well as over space.

On the other hand, while explaining "Moribund deltaic plain", the word 'Moribund', according to oxford dictionary, means "in terminal decline" or "lacking vitality or vigour". In other words, the word 'Moribund' refers to "a literal or figurative state near death". The word 'Moribund' synonymously used as declining or 'decaying' or 'dying' etc. A deltaic plain is a plain formed by deposition of silt at the mouth of a stream or by overflow along the lower stream courses. So a moribund deltaic plain means a deltaic or alluvial plain where the river systems are losing their force and gradually dying and transforming the deltaic plain into an inactive one.

The western part of the great Padma and Bhagirathi-Hooghly delta is known as the moribund delta comprising north-western part of Bangladesh and the north-eastern part of the deltaic plain of West Bengal in India including three districts-Murshidabad(only the eastern part of Bhagirathi), Nadia, and North 24 Parganas. The Jalangi, Churni, Mathabhanga, Ichhamati and Bhairab are decaying rivers of the moribund deltaic plain of West Bengal. In the present study, the Spatio-temporal variation in hydromorphological characteristics of Jalangi River will be analyzed.

RESEARCH QUESTION:

The specification of research question or hypothesis is an extremely important part of any research project. In the present hydromorphological research, following questions can be asked.

1. How different are the hydrological and morphological processes of a dying river in the inactive part of the world's largest delta and how relevant it is?
2. What is the extremity of natural riverine process and how does it influence the local habitats?
3. How can the extreme events be reduced to sustain a healthy man-nature relationship?

OBJECTIVES OF THE STUDY:

- To make an appraisal of the hydromorphological characteristics of the Jalangi river in moribund deltaic plain of West Bengal.
- To assess the spatio-temporal dynamism of hydromorphological characteristics of the Jalangi river in moribund deltaic plain of West Bengal.
- To assess the causes and dimensions of the problem of channel migration in relation to hydromorphological characteristics of the Jalangi river in moribund deltaic plain of West Bengal.
- To assess the vulnerability of channel migration, flood, bank erosion and siltation of the Jalangi river in moribund deltaic plain of West Bengal in relation to their hydromorphological behavior.
- To assess the consequences of the changing hydromorphological behavior of Jalangi river.
- To illustrate structural and non structural measures and their effectiveness for sustenance.

DATA BASE AND METHODOLOGY: (PLAN OF WORK):

The study area is an important physiographic region of the Bengal Delta. To fulfill the aforesaid objectives following methodological phases are to be followed. The methodology can be divided into three principal phases.

Phase – I: Pre-field Methods

The objective of this phase is to gain preliminary knowledge about the area under study from the existing reports, literature, maps and diagrams, satellite imageries and aerial photographs etc. so that the field work can be carried out systematically. For that purpose the following steps are to be followed.

1. Collection of the District Planning Maps of Murshidabad and Nadia districts published by National Atlas and Thematic Mapping organization (NATMO) and Survey of India, Government of India.
2. Collection of a complete cover of survey of India topographical sheets on two different scale i.e. 1:50,000 and 1:250, 000.
3. Collection of Geological Maps published by Geological Survey of India, Government of India.
4. Collection of aerial photographs and satellite imageries of the moribund delta region from the department of space, Govt. of India.
5. Collection of the available literature, maps, imageries and photographs.
6. Collection of climate data of different meteorological station from the Meteorological Department, Government of West Bengal, India.
7. The sample sites are to be selected randomly so that each hydromorphological unit, soil type and water sample can be collected.
8. Collection of ground water table data of different parts of the study area from central ground water Board, Government of India.
9. Collection of population data from Census Department, Government of India.
10. Other necessary statistical data are to be collected from Bureau of Applied Economics and statistics, Government of West Bengal, India.
11. Preparation of questionnaire for collection of socio-economic information and record on practical experiences of the local people.

Phase – II: Field work methods

This phase consists of the following steps.

The field work is divided into three phases – (a) Pre-monsoon (March to May); (b) Monsoon (June to October) and (c) Post-Monsoon (November to February) seasons.

1. Verification of the information collected from the literature, maps, imageries and photographs.
2. Surface and profile soil samples, surface water and ground water table data are to be collected from the selected sites during field tours in different seasons (i.e. Pre-Monsoon, Monsoon and Post Monsoon seasons).
3. During field work, collection of necessary information regarding characteristics of the local hydrological condition, nature of land forms and surface characteristics of the terrain, biogeographic characteristics, climatic characteristics etc. are to be recorded in a tabular form.
4. Collection of information from the local people through questionnaires during the field work.
5. The necessary information (i.e. agricultural crops cultivation, availability of ground water, demand of water etc.) and observations are also to be noted and recorded.
6. Personal feeling based on the field observations are to be recorded.

Phase-III: Post-field Methods

The last phase of work includes laboratory analysis of the soil and water samples, statistical analysis of the data and final preparation of report.

1. Soil and water samples are to be analyzed like soil texture, ph level, salinity etc. by using appropriate methods.
2. Climatic data and hydrological data are to be analyzed and correlated.
3. Physical and socio-economic data are to be analyzed and correlated.
4. Ground water data are to be analyzed.
5. Finally, the interpretation and necessary recommendations are to be made for sustainable development of the region and recommendations for future socio-economic development and planning.

SELECTION OF THE STUDY AREA:

The Geophysical setting of the Gangetic delta is a unique ecological character between the Padma and Bhagirathi-Hooghly river system. It is located in Bangladesh and West Bengal in India. The study area comprises the northern part of deltaic plain of West Bengal. It is bounded by the river Padma which is also the international boundary of Bangladesh in the north and east, the Padma bil in the south and the river Bhagirathi in the west. There are many abandoned meanders, marshes, lakes which are increased towards the south.

Jalangi river, a branch of the Ganges, after being originated from the river Padma at the coordinates of 24°17'58"N and 88°26'45"E in the northern most portion of Murshidabad district, it flows almost in a southern direction in an acute meandering pattern through the districts of Murshidabad and Nadia of Indian state of West Bengal. After reaching the town of Krishnanagar, the river takes a western direction to meet Bhagirathi near Nabadwip-Myapur at the coordinates of 23°24'42"N and 88°22'50"E. After the confluence of Bhagirathi and Jalangi, the Bhagirathi river is known as river Hooghly. However, the characteristics of Jalangi river are not that simple as it seems to be. The source of the river has dried up due course of time. Seasonal flow, drying up of the source, changing position of the off-take points are the characteristic features of the study.

RELEVANCY OF THE SELECTION OF STUDY AREA:

The Moribund delta is characterized by heavily sediment laden entrenched rivers with low discharge capacities, an abundance of cut-off meanders and large areas of plains high above normal flood levels. The rivers of the moribund deltaic plain tend to raise its own bed or channel by the deposition of the silt, sand and clay. It holds suspended sediments in its water and by this gradual deposition the channel bed of the streams is raised above the actual level. The waters of the Ganges with its tributaries have gradually shifted their flow and easily culminating towards Gomati-Madhumati and Padma and the region has signs of decaying rivers. So, a distinct spatio-temporal variation has been noticed in the hydromorphological behavior of the existing rivers.

River Jalangi is one of the major rivers of the moribund delta in West Bengal which is characterized by loop channels, cut-off meanders, marshes, wetlands and ox-bow lakes. Changing channel pattern, formation of marshes, frequent inundation have great impact on the regulation of its economic condition. There is dearth of study in the geo-spatial mapping and in-

depth study on hydromorphological dynamisms of this region. So the present work may be considered as the new approach to the micro-level study of the region.

LITERATURE REVIEW:

Evolution of Rural Settlements in West Bengal, 1850-1985: (1989)

In the year 1989, the authors of this work Sukla Sen and Jyotirmoy Sen have accounted the geophysical characteristics and evolution of rural settlements of the moribund deltaic plain of West Bengal. They have discussed the livelihood of the dwellers which is mostly depending on the local geographical and physiographic characteristics.

Regional Geography of the Moribund Ganga Delta, West Bengal: (1990)

In the year 1990, the authors of this work Sukla Sen(Dasgupta) and Jyotirmoy Sen have tried to account all the geographical characteristics by covering both the physical and socio-economic characteristics of the moribund deltaic plain of West Bengal. Especially the physiographic division of the region and their characteristics is very helpful.

Stratigraphic Evolution of the Late Holocene Ganges–Brahmaputra Lower Delta Plain: (2001)

In the year 2001, the authors of this work M.A. Allison et al tried to build a model for the sedimentary sequence by examining sedimentological character, clay mineralogy, elemental trends, and C geochemistry etc. in order to understand the Stratigraphic evolution of Ganga-Brahmaputra lower delta plain. A successive formation of muddy sand to inter-bedded mud, progradation of shoal-island complexes and the transition from sub-tidal to inter-tidal conditions have been accounted during the study.

Late Quaternary Geology and Alluvial Stratigraphy of the Ganga Basin: (2005)

In 2005, R. Sinha et al presented an overview here by emphasizing the need for an integrated approach to understand the complexities of the geomorphic form and Stratigraphic development over the vast tract of the Ganga plain. It is derived that both the upper and middle Ganga plains have remained outside the influence of the sea level fluctuation, while climate and to some extent tectonics have been the major controlling factor in stratigraphic development of the basin. In

contrast, the lower Ganga plain and the deltaic region have been influenced by interplay of climate, tectonics and eustasy throughout the late quaternary.

Processes of Delta Formation in the Mouth Area of the Ganges and Brahmaputra Rivers: (2006)

In June 2006, V.N. Mikhailov and M.A. Dotsenko discussed the evolution of the Ganges and Brahmaputra river delta during the Holocene i.e. the post-glacial period. An attempt has been made to analyze the process of delta formation, the dynamics of the delta hydrographic system, the channel process in the river branches, dynamics of the delta coastline, nearshore zone bed and the sediment budget in the mouth area of these rivers. To analyze these aspects, the emphasis has been given to the peculiarities of the water regime of both rivers, flood during south west monsoon, tidal phenomena and catastrophic surges caused by tropical cyclones.

Groundwater Management for Sustainable Rural Development in the Gangetic Delta, India: (2008)

In the year 2008, the author of this work Dr. Ajit Kumar Bera basically tried to discuss the groundwater management and its impact on the gangetic delta of India. Prime focus was on the ever-increasing use of groundwater for irrigation purpose in the agricultural activity specially in the post-green revolution period. But he ignored other uses such as the industrial and domestic purposes. However, the models showing stages of planning and management for sustainable development in the region focusing on the sectors like- primary development and food production, waste water uses, and finally water resource and employment generation are key works.

Mangrove Wetland Ecosystems in Ganges-Brahmapura Delta in Bangladesh: (2008)

In the year 2008, the authors of this work Shafi Noor Islam and Albrecht Gnauck tried to analyze the present degraded mangrove wetland ecosystems and their negative impact by analyzing the increasing salinity of 13 rivers from sundarbans of Bangladesh. The impact of construction of Farakka barrage which resulted in decrease in the fresh water discharge on the river Ganga have been taken into consideration. Increased salinity and degraded ecosystems of the sundarbans, loss of biodiversity and threats for coastal food security, resultant diseases are the key components of this work.

Evolution of Ganges–Brahmaputra Western Delta Plain: Clues From Sedimentology and Carbon Isotopes: (2009)

In 2009, by studying sedimentology, carbon isotope and sequential Stratigraphic analysis of sub-surface sediments of western Ganga-Brahmaputra delta plain, the authors of this work A. Sarkar et al tried to account a late quaternary marine clay and fluvial channel-overbank sediments which are traceable below the Holocene strata.

Floodplain Evaluation in The Ganga Brahmaputra Delta: A Tectonic Review: (2011)

In 2011, the authors of this work V.C. Jha and H.P. Bairagya tried to account the formation of geomorphic features of Bengal basin , particularly the floodplain by analyzing the geological set up and the tectonic events. The investigation have been made by sequential analysis of the formation of Indo-Gangetic plain, formation of Bengal plain and its sedimentation, formation of Bengal delta, physiography of the floodplain, processes of floodplain in the Bengal delta, influence of the changing river courses on the formation of flood plain, rocks, minerals and metallic content of the plain etc.

Decadal Change in the Surface Water Salinity Profile Of Indian Sundarbans: A Potential Indicator of Climate Change: (2013)

In the year 2013, the author of this work Kakoli Banerjee have tried to point out the variation in salinity of water in sundarbans as an indicator of global climate change. The author have accounted the declining salinity of the western rivers like Hooghly and Muriganga due to the increased amount of melt water from Gangotri. Rivers of central sundarbans are marked by increasing salinity due to siltation, mixing with ocean water and possible global warming led evaporation. Lowering of salinity in the rivers of eastern sundarbans due to the fresh water supply by the river Padma and Brahmaputra have been marked. Other than these climatic effects, human intervention and intrusion of marine phytoplankton species have also been considered as the indicator of the increased salinity profile in the central sundarbans.

Piecing Together the Ganges-Brahmaputra-Meghna River Delta: Use of Sediment Provenance to Reconstruct the History and Interaction of Multiple Fluvial Systems during Holocene Delta Evolution: (2014)

In 2014, the authors of this work Steven L. Goodbred Jr. et al tried to present a new insight into the Holocene construction of the Ganga-Brahmaputra-Meghna delta, with a focus on river sedimentation, channel migration and avulsion history. The isolated presence of these three rivers in the early Holocene, followed by gradual closing of these rivers in the mid Holocene and the cumulative work of sediment formation during the late Holocene has been marked.

Dibyendu Mondal
Research Scholar
Dept. of Geography.
Visva-Bharati
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